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NSC Synchrotron Radiation Research Center Steps Up Promotion of Radiation Applications

Beginning in April 1994, beamlines at the NSC's Synchrotron Radiation Research Center went on-line for trial use by research organizations and academic institutions in Taiwan, thereby providing opportunities for research in physics, chemistry, materials science, biology, and other areas. The capabilities of the three beamlines available during the trial use phase—lm-SNM, 6m-LSGM, and 6m-HSGM—surpassed those of any similar-type beamlines at overseas synchrotrons. From April to December 1994, a total of 71 experimental opportunities were provided to more than 10 research organizations, and the beamlines were used by 202 researcher person-times. Most experiments were performed very successfully, thus greatly raising the domestic level of research expertise in the area of synchrotron radiation. The total length of synchrotron operating time in the period from April to December was 2,500 hours, and the average utilization rate was over 90%. Although some sporadic shut-downs were encountered during this nine-month trial operation period, after accumulating operating experience and making needed improvements, it is now believed that the synchrotron's operating rate will exceed 95% in 1995. At present the time needed by radiation users has already exceeded the time avilable. To resolve this situation of supply being unable to meet the demand, the Center plans to serve radiation users by providing 20 beamlines to be gradually built over successive years.

The establishment of common participation research team (PRT) experiment stations begins when research groups with similar research orientations make a proposal to the NSC for an experiment station. Afterwards Center personnel assist with the design and construction of the experiment station. As soon as construction is complete, the station is moved into an experimental area and connected to a beamline in preparation for use. At present the NSC has already reviewed and approved five PRTs; one is in the midst of the application process. These research groups originate from 27 domestic research organizations or institutions of higher learning, and include a total of more than 80 research workers. The Center is currently planning to formally open joint utilization beamlines for the use of all scientific researchers on July 1, 1995, thereby boosting standards of academic research in the R.O.C. and helping promote international academic exchange.

The Center's important tasks during the second phase of operation are as follows: (1) enhancing the storage ring's capabilities—in the future all types of insertion devices meeting the experimental needs of radiation users will be first installed on the storage ring and then opened for use immediately after successful commissioning; (2) boosting of electron storage ring capabilities-high radiation quality and stable luminous flux will be maintained and injector, measurement, radiation shielding, and safety systems will be improved; (3) necessary refitting will be performed in order to install insertion magnets—storage ring energy will be increased from 1.3 GeV to 1.5 GeV and machine capabilities brought up to date.

As for the research applications of synchrotron radiation, both (1) X-ray lithography development and (2) micromachining development programs are in the midst of development at the Center. It is hoped that these programs will bring together human resources in these fields, boost domestic industrial semiconductor technology, and help convert the nation's sunset industries into high-tech industries.

Radiation research promotion and education are ongoing long-term goals at the Center. Programs to help achieve these goals include: (1) efforts to disseminate radiation information, such as convening sci-tech seminars and lectures, producing promotional items, establishing a display room, and extensively establishing relevant curricula at colleges and universities; (2) encouraging students and faculty at colleges and universities to tour the facility and participate in synchrotron operation and experimental work, and conducting activities in which students may take part in research and facility operations during school vacations; (3) actively participating in international conferences and academic organizations, and establishing cooperative research methods and channels in conjunction with overseas laboratories; (4) conducting a regular annual users' conference for the purpose of disseminating research results and papers.

The NSC's "Computer Systems Technology R&D Focus Center Group" Plan Formulated

In the wake of the domestic information industry's flourishing development in recent years, information-related university departments and graduate schools have rapidly been established or enlarged. As a result, the number of researchers in this field has increased sharply and the research atmosphere has become steadily more energetic. In order to effectively integrate the efforts of the domestic academic sector and elevate the R.O.C.'s standing in the field of information research, the National Science Council (NSC) is carrying out R&D tasks related to computer systems. In addition, in order to better reap practical results from academic research, bind the industrial sector tighter to R&D organizations, and boost cooperation between industry and academia—thereby smashing through bottlenecks in computer R&D, enhancing the computer industry's technological R&D ability, and strengthening domestic industry's competitive strength in the international marketplace—the NSC has draw up a plan for establishing the "Computer Systems Technology R&D Focus Center Group."

During the initial period of this plan, "Focus Centers" will be established at National Taiwan University, National Tsing Hua University, National Chiao Tung University, and National Cheng Kung University; these universities have been provisionally selected because of their abundant resources and strong R&D capabillity. The major tasks of the Centers will include: (1) performing integrated research on regular research projects, integrated research projects, and cooperative industry-academia research projects; (2) promoting cooperation between industrial and academic sectors by surveying the research needs of both sectors, providig industrial consulting services, publishing research results, performing curriculum training, and implementing technology transfer; (3) strengthening R&D support by conducting seminars on topics related to the research focal points of the Centers and facilitating overseas travel to attend conferences and carry out fact-finding tasks. During the first year after the establishment of the Focus Centers, conveners from the academic field of information science will temporarily be responsible for mutual planning, contact and coordination tasks. Beginning in the second year, a university will be chosen for the establishment of a "Coordination Center." In addition, an "Outstanding Center" will subsequently be selected based on research results.

After thoroughgoing discussions at the many conferences held by the planning committee, the primary and secondary research focus areas of the four Centers have been drawn up as follows:

1. National Taiwan University: multi-element dispersed systems technology and applications.
2. National Tsing Hua University: high-speed networks and communications technology and applications.
3. National Chiao Tung University: high-performance computer system frameworks and applications, intelligent human-machine interfaces.
4. National Cheng Kung University: dispersed systems technology and applications, intelligent input and output systems.

After review by each Center, the NSC has checked and approved a total of 24 integrated research projects for the 1995 fiscal year distributed as follows: National Taiwan University—8 projects, National Tsing Hua University—3 projects, National Chiao Tung University—9 projects, and National Cheng Kung University—4 projects. The total of 115 researchers with the title of associate professor or above participating in these projects are distributed as follows: National Taiwan University—35 persons, National Tsing Hua University—16 persons, National Chiao Tung University—47 persons, and National Cheng Kung University—17 persons. Apart from this, a total of 395 Ph.D. and Master program graduate students are also participating in these projects as follows: National Taiwan University—123 persons, National Tsing Hua University—56 persons, National Chiao Tung University—165 persons, and National Cheng Kung University—51 persons.

In the future each Focus Center will take as its core activity the primary and secondary focus areas that have been put forward, and actively work to integrate intramural and extramural human resources and research projects, thereby shaping a tightlystructured team research environment. As a consequence, the establishment of the four Focus Centers will generate the following benefits: (1) concentrating research energies on individual research focal points, (2) bolstering the degree of integration of integrated research projects, (3) promoting the establishment of even more industry-academia cooperative projects, (4) strengthening the dissemination of the results of research at each Center-including patent applications and technology transfer, (5) coordinating joint indjustry-academia cooperative projects at various Centers in cases of duplication, (6) proposing and performing studies of forward-looking multi-university integrated research topics and projects, and (7) collecting information concerning markets and manufacturer needs and establishing avenues for dialogue between industry and academia, thereby achieving the goal of "letting industry drive academic research, and helping academia guide industry."

Current Status of Technology Transfer in the R.O.C. Space Program

In accordance with the "National Space Technology Long-Term Development Plan" ratified by the Executive Yuan, the R.O.C.'s space program not only seeks to carry out its originally assigned tasks, but also emphasizes the

realization of technology transfer and does not neglect the dissemination and promotion of technology. On February 25, 1995, the National Science Council (NSC) led by Chairman Nan-Hung Kuo convened the "Space Program Industry Government-Academia-Research Coordination Conference for Participating Units," at which it was emphasized that the space program would lend impetus to the growth of related industries and the raising of product quality. The space program is to be implemented in stages that will begin with the establishment of ground facilities and gradually proceed to the determination of specifications for space-going equipment. Eventually the space program's stringent quality control approach and capability will be extended to industrial, governmental, academic, and research sectors, promoting the nation's industrial upgrading. At present the main objective as far as technology transfer and dissemination are concerned consists of acquiring an autonomous satellite systems hardware and software design and modification capability. This will be accomplished through the simultaneous activities of teams "A" and "B". Team A will take advantages of opportunitis to design, research, and manufacture satellite systems, thereby acquiring new technologies. At the same time it will also insure the successful completion of the appointed tasks. Apart from technology transfer, Team B will also place heavy stress on the dissemination of technology. This group will push forward satellite R&D work via the implementation of cooperative projects pairing industry with academia. Below is a description of the current status of technology transfer within the space program's various principal subsidiary projects:

1. Spacecraft development project

This project is a continuation of the work done in approving system requirements and confirming interface specifications, and has already entered the stage of preliminary design of spacecraft systems. The project currently employs 28 persons including technology transfer personnel, a team leader, and a representative stationed in-plant. All personnel utilize various channels to assist domestic colleagues and other subsidiary projects (including satellite testing and the testing of domestically-produced components and structures) in learning technology and acquiring relevant information.

2. Payload development project

A. Ocean color

When the results of price bidding for the commissioned fabrication of ocean color imaging camera instrumentation were announced on March 17, 1995, the winning bid had been made by NEC Inc. of Japan. It is projected that the instrumentation will be completed and delivered within 24 months after the contract is signed and work begun. The execution of this project will include technology transfers that will effectively enable new technologies to take root locally. The different parts of the project include telescope design and analysis, camera head fabrication, packaging, alignment and coregistration, CCD electronics optimization, and radiometry and system calibration. The Science Data Distribution Center (SDDC) and science team have already been established; their work will include the processing, calibration, and distribution of scientific data, and the study and formulation of applications projects.

B. Ionospheric Plasma Electrodynamic Instrument (IPEI)

The cooperative format of this project is to let the University of Texas at Dallas (an overseas cooperative unit) employ personnel trained of the National Space Program Office to design and fabricate the relevant hardware and software, thereby allowing them to acquire practical on-site work experience. Technologies to be adopted include: design and fabrication of the main electrical package (MEP), design and fabrication of ground support equipment, assembly, testing, and payload calibration.

C. Experimental Communication Payload (ECP)

This project consists of ground, space, and experimental portions. The space portion constitutes the Ka-band bent-pipe experimental communication payload and the ground portion constitutes the Ka-band hub and remote terminal. Spacegoing equipment has already been fabricated by Micro Electronics Technology Inc. (MTI), and in cooperation with NEC, technology transfer and fabrication of experimental instrumentation is currently underway. As for the experimental portion of this project, the National Space Program Office (NSPO) is in the midst of seeking scientific team members from the academic and research sectors to perform overall planning of experiments. Experiment categories include voice, data, and fax transmission experiments, digital communications experiments, and electric wave broadcasting experiments.

3. Domestically-produced satellite component program

The various satellite components include on-board computer (OBC), remote interface unit (RIU), Antenna, RF assembly, solar panel assembly, power regulator, and control unit. Domestic firms have been notified that they may present applications to produce these items, and company qualifications and technical capabilities have already been investigated. Price and contract negotiations are currently ongoing. In addition, the essential points of the satellite structural testing contractor's participation in research and development tasks have been worked out on a preliminary basis.

4. The ROCSAT ground system

Formally begun on January 17, 1995, this project seeks to effect the transfer of technology. On February 22 and 23 of this year the National Space Program Office dispatched personnel to the domestic firms Tatung CO; SYSCOM Computer Engineering Corp. (SYSCOM Corp.), Taiwan Telecommunication Network Service Cor. (TTNS Co.), and Chung-Ting Conslutant Incoporation (CTCI Corp.) in order to better understand their organization, facilities, and capabilities. After taking into consideration the type of spacecraft, this project will select and dispatch four workers to the Allied Signal Technology Service Corporation (ATSC) in the U.S. for training; personnel are presently in the midst of the screening and selection process. The work content of team B is currently being coordinated with ATSC team members will be selected primarily from domestic non-profit organizations.

The NSC's Ocean Research Fleet Is a Driving Force Behind Ocean Technology Research

As the world's land-based resources are now overdeveloped and ever more depleted, many nations are in a race to study and develop the ocean's abundant resources. Taiwan is small and densely populated with more than 21 million people living crowded on an island of only 36,000 square kilometers; since the land is largely mountainous, only about one-fourth of this area is actually habitable. As a consequence, Taiwan's scanty land-based resources are already developed to the greatest possible degree.

In spite of this situation, it must be kept in mind that Taiwan is also surrounded by the ocean on all sides, and has a coastline 1566 kilometers long. In the past, because of the influence of economic conditions, charts and information on coastal geology and hydrology were very lacking. Besides being needed for the development of ocean resources, these materials can also be widely used in conjunction with such areas as national defence, transportation, and tourism. The ocean influences the climate of Taiwan, and the climate in turn affects crop harvests, water levels in rivers, and transportation conditions, etc. In addition, environmental problems such as the destruction of marine resources and pollution of the coastal environment caused by industrial development urgently await solutions. As a result, the R.O.C. is including the advancement of ocean technology among its core technologies to be developed in the future, and in order to vigorously promote the study and development of ocean technologies, the National Science Council (NSC) has taken responsibility for establishing a fleet of three ocean research vessels. The outstanding facilities of these ships will enable domestic ocean research personnel to participate in many large-scale research projects of the R.O.C. or in cooperation with other nations. Tasks in these projects will include coastal and oceanic surveys, observations, measurements, and sampling operations.

The vessel of Ocean Researcher-I was built for the NSC in Norway; after its launch and delivery in 1984, management responsibility was given to National Taiwan University. The Ocean Researcher-I is 50 meters long, 10.3 meters wide, has a draft of 4.3 meters, a tonnage of 792 tons, and a maximum cruising speed of 14.3 knots. This multi-purpose medium-size research vessel has a full complement of highquality ocean and planet survey equipment, providing marine research personnel at domestic universities with numerous opportunities to participate in research projects including hydrological surveys and sampling of seawater and seabottom geology. The following is a summary of major research projects involving this vessel:

1. Large-scale international cooperation projects such as the "World Ocean Circulation Experiment" (WOCE).
2. The "Kuroshiro Edge Exchange Process" project (KEEP).
3. The "Tropical Ocean and Global Atmosphere Project."
4. Basic marine biology research.
5. Establishment of marine charts and data bases for the vicinity of Taiwan.
6. Pelagic fisheries and combined surveys.

At present Ocean Researcher-I's working schedule is completely full and workload exceeds the normal level. The ship spends more than 250 days a year working at sea and—despite the fact that it cannot keep up with the demands placed on it—has delivered notable results.

The vessels of Ocean Researcher-II and III have a length of 38 meters, beam of 7.8 meters, draft of 3.4 meters, tonnage of 250 tons, maximum cruising radius of seven days, maximum cruising speed of 13.5 knots, and crew of 16 persons. These ships represent the first time that small ocean research vessels have been designed and built in Taiwan. After their completion and delivery in December 1993, the NSC respectively entrusted the National Taiwan Ocean University in Keelung and National Sun Yat-Sen University in Kaohsiung with the management of the Ocean Researcher-II and III. The following is a brief description of the functions of these vessels:

1. These vessels will provide students and faculty in the oceanography departments at domestic universities opportunities to verify what they have learned and actually engage in at-sea research training, thereby enhancing their research ability and interest in learning.
2. In order to relieve the Ocean Researcher-I's excessive workload and remedy its inability to perform research in inshore waters, these vessels will enage in investigations of the hydrological environment of inshore waters and around river-mouths, and will perform surveys of inshore organisms and fisheries ecology.
3. These vessles will participate in large-scale research projects simultaneously and in conjunction with Ocean Researcher-I; this cooperative division of labor will insure even more thoroughgoing results.
4. Having two additional vessels will enable operations in the vicinity of harbors (such as Kaohsiung and Keelung harbors) without the necessity of long-distance north-south travel. This will increase efficiency and enable savings in the money and time consumed by long-distance cruising.
5. In the case of coastal fishing ground and ocean resource development by means of such efforts as exploitation of inshore sand and gravel deposits, exploration for oil and gas, and utilization of the ocean temperature differential off the east coast of Taiwan to generate power, these vessels will be employed to perform research and surveys of marine geology, topography, currents, and biology.

The "Mid-Term Ocean Technology Plan" approved by the Executive Yuan has laid out the nation's plan to establish a high-efficiency research fleet that can develop and protect the R.O.C.'s economically-valuable ocean resources. Taking into consideration actual developments, in the future the NSC will plan and construct a large research vessle (2000 ton class) and deep sea submersible devices in order to carry out pelagic and deep sea research. This will expand the scope of the R.O.C.'s ocean research and survey operations and grdually attain the nation's mid-term objectives.

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